

Patent Application No. 10/092,407

IN THE CLAIMS:

Please amend claims 1, 5, 9 and 13, and add new claims 17-20 as follows:

1. (currently amended) A signal processing method for a digital signal comprising the steps of:

establishing a Yule-Walker equation having the following form by using a matrix that includes, as components, the elements of a Galois field $GF(2^m)$ applied to Reed-Solomon codes having an arbitrary minimum distance, and a vector that includes, as components, said elements of said Galois field $GF(2^m)$

$$\begin{pmatrix} S_0 & S_1 & \cdots & S_{l-1} \\ S_1 & S_2 & \cdots & S_l \\ \vdots & \vdots & \ddots & \vdots \\ S_{l-1} & S_l & \cdots & S_{2l-2} \end{pmatrix} \begin{pmatrix} \Lambda_1^{(l)} \\ \vdots \\ \vdots \\ \Lambda_1^{(l)} \end{pmatrix} = \begin{pmatrix} S_l \\ \vdots \\ \vdots \\ S_{2l-1} \end{pmatrix};$$

obtaining the solution of said Yule-Walker equation without
10 conditional branching as the following determinants

$$\tilde{\Lambda}_i^{-(l)} = \begin{vmatrix} S_0 & S_1 & \cdots & S_{l-1} \\ \vdots & \vdots & \ddots & \vdots \\ S_{l-i-1} & S_{l-i} & \cdots & S_{2l-i-2} \\ S_{l-i+1} & S_{l-i+2} & \cdots & S_{2l-i} \\ \vdots & \vdots & \ddots & \vdots \\ S_l & S_{l+1} & \cdots & S_{2l-1} \end{vmatrix}, i=1, \dots, l-1;$$

employing Jacobi's formula, $\Gamma_i^{(l+1)} \Lambda_0^{hal(l)} + (\Lambda_1^{hal(l)})^2 = \Lambda_0^{hal(l+1)} \Gamma_i^l$, to

enable the calculation of the solution $\tilde{\Lambda}_i^{(l)}$ (hereinafter referred to as $\Lambda_i^{hal(l)}$) to result in the calculation of the following determinants of

15 the symmetric matrices

$$\Gamma_i^{(l+1)} = \begin{vmatrix} S_0 & \cdots & S_{l-1-i} & S_{l+1-i} & \cdots & S_l \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ S_{l-1-i} & \cdots & S_{2(l-1-i)} & S_{2(l-i)} & \cdots & S_{2l-1-i} \\ S_{l+1-i} & \cdots & S_{2(l-i)} & S_{2(l+1-i)} & \cdots & S_{2l+1-i} \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ S_l & \cdots & S_{2l-1-i} & S_{2l+1-i} & \cdots & S_{2l} \end{vmatrix}$$

(where $i = 0, \dots, l$);

determining the number of errors to be the maximum matrix size

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that corresponds to said obtained solution that is not zero; and
 20 determining whether said number of errors equals the maximum
 number of correctable errors in the digital signal.

2. (original) The signal processing method according to claim 1,
 wherein the components of said determinant are syndromes that include
 said elements of said Galois field $GF(2^m)$.

3. (original) The signal processing method according to claim 1,
 wherein said syndromes are generated by digital signals transmitted
 using wavelength division multiplexing.

4. (original) The signal processing method according to claim 1
 that is used for at least one of the decoding of digital signals and
 error correction.

5. (currently amended) A system for processing a digital signal
 comprising:

an encoding unit, for encoding a received digital signal;

a decoding unit, for decoding said digital signal that is

5 encoded; and

an output unit, for outputting said decoded digital signal,
 wherein said decoding unit includes

means for establishing a Yule-Walker equation having the
 following form by using a matrix that includes, as components, the
 10 elements of a Galois field $GF(2^m)$

$$\begin{pmatrix} S_0 & S_1 & \cdots & S_{l-1} \\ S_1 & S_2 & \cdots & S_l \\ \vdots & & \ddots & \vdots \\ S_{l-1} & S_l & \cdots & S_{2l-2} \end{pmatrix} \begin{pmatrix} \Lambda_1^{(l)} \\ \vdots \\ \vdots \\ \Lambda_l^{(l)} \end{pmatrix} = \begin{pmatrix} S_l \\ \vdots \\ \vdots \\ S_{2l-1} \end{pmatrix},$$

means for obtaining the solution of said Yule-Walker equation
 without conditional branching as the following determinants

$$\tilde{\Lambda}_i^{(l)} = \begin{vmatrix} S_0 & S_1 & \cdots & S_{l-1} \\ \vdots & \cdots & \ddots & \vdots \\ S_{l-i-1} & S_{l-i} & \cdots & S_{2l-i-2} \\ S_{l-i+1} & S_{l-i+2} & \cdots & S_{2l-i} \\ \vdots & \cdots & \ddots & \vdots \\ S_l & S_{l+1} & \cdots & S_{2l-1} \end{vmatrix}, i=1, \dots, l-1;$$

15 means for employing Jacobi's formula,

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$\Gamma_i^{(l+1)} \Lambda_0^{hat(l)} + (\Lambda_1^{hat(l)})^2 = \Lambda_0^{hat(l+1)} \Gamma_i^l$, to enable the calculation of the solution $\tilde{\Lambda}_i^{(l)}$ (hereinafter referred to as $\Lambda_i^{hat(l)}$) to result in the calculation of the following determinants of the symmetric matrices

$$\Gamma_i^{(l+1)} = \begin{vmatrix} S_0 & \cdots & S_{l-1-i} & S_{l+1-i} & \cdots & S_l \\ \vdots & & \vdots & \vdots & & \vdots \\ S_{l-1-i} & \cdots & S_{2(l-1-i)} & S_{2(l-i)} & \cdots & S_{2l-1-i} \\ S_{l+1-i} & \cdots & S_{2(l-i)} & S_{2(l+1-i)} & \cdots & S_{2l+1-i} \\ \vdots & & \vdots & \vdots & & \vdots \\ S_l & \cdots & S_{2l-1-i} & S_{2l+1-i} & \cdots & S_{2l} \end{vmatrix}$$

20 (where $i = 0, \dots, l$),

means for determining the number of errors to be the maximum matrix size that corresponds to said obtained solution that is not zero; and

25 means for determining whether said number of errors equals the maximum number of correctable errors.

6. (original) The system according to claim 5, wherein said encoding unit is configured for encoding said received digital signal to syndromes that consist of said elements of said Galois field $GF(2^m)$.

7. (original) The system according to claim 5, wherein said received digital signals are transmitted using wavelength division multiplexing.

8. (original) The system according to claim 5 that is used for at least one of the decoding of digital signals and error correction.

9. (currently amended) A program embodied in a tangible computer-readable medium for processing a digital signal, permitting a computer to perform the steps of:

5 establishing a Yule-Walker equation having the following form by using a matrix that includes, as components, the elements of a Galois field $GF(2^m)$, and a vector that includes, as components, said elements of said Galois field $GF(2^m)$

$$\begin{pmatrix} S_0 & S_1 & \cdots & S_{l-1} \\ S_1 & S_2 & \cdots & S_l \\ \vdots & & \ddots & \vdots \\ S_{l-1} & S_l & \cdots & S_{2l-2} \end{pmatrix} \begin{pmatrix} \Lambda_1^{(l)} \\ \vdots \\ \vdots \\ \Lambda_l^{(l)} \end{pmatrix} = \begin{pmatrix} S_l \\ \vdots \\ \vdots \\ S_{2l-1} \end{pmatrix},$$

obtaining the solution of said Yule-Walker equation without

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10 conditional branching as the following determinants

$$\tilde{\Lambda}_i^{(l)} = \begin{vmatrix} S_0 & S_1 & \cdots & S_{l-1} \\ \vdots & \cdots & \ddots & \vdots \\ S_{l-i-1} & S_{l-i} & \cdots & S_{2l-i-2} \\ S_{l-i+1} & S_{l-i+2} & \cdots & S_{2l-i} \\ \vdots & \cdots & \ddots & \vdots \\ S_l & S_{l+1} & \cdots & S_{2l-1} \end{vmatrix}, i=1, \dots, l-1;$$

employing Jacobi's formula, $\Gamma_i^{(l+1)} \Lambda_0^{hat(l)} + (\Lambda_1^{hat(l)})^2 = \Lambda_0^{hat(l+1)} \Gamma_i^l$, to

enable the calculation of the solution $\tilde{\Lambda}_i^{(l)}$ (hereinafter referred to as $\Lambda_i^{hat(l)}$) to result in the calculation of the following determinants of

15 the symmetric matrices

$$\Gamma_i^{(l+1)} = \begin{vmatrix} S_0 & \cdots & S_{l-1-i} & S_{l+1-i} & \cdots & S_l \\ \vdots & & \vdots & \vdots & & \vdots \\ S_{l-1-i} & \cdots & S_{2(l-1-i)} & S_{2(l-i)} & \cdots & S_{2l-1-i} \\ S_{l+1-i} & \cdots & S_{2(l-i)} & S_{2(l+1-i)} & \cdots & S_{2l+1-i} \\ \vdots & & \vdots & \vdots & & \vdots \\ S_l & \cdots & S_{2l-1-i} & S_{2l+1-i} & \cdots & S_{2l} \end{vmatrix}$$

(where $i = 0, \dots, l$);

determining the number of errors to be the maximum matrix size that corresponds to said obtained solution that is not zero; and

20 determining whether said number of errors equals the maximum number of correctable errors in the digital signal.

10. (original) The program according to claim 9, wherein the components of said determinants are syndromes that consist of said elements of said Galois field $GF(2^m)$.

11. (original) The program according to claim 9, wherein said syndromes are generated by digital signals transmitted using wavelength division multiplexing.

12. (original) The program according to claim 9 that is used for at least one of the decoding of digital signals and error correction.

13. (currently amended) A computer-readable storage medium on which is recorded a program used for an error correction method, said program permitting a computer to perform the steps of:

5 establishing a Yule-Walker equation having the following form by using a matrix that includes, as components, the elements of a Galois

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field $GF(2^m)$, and a vector that includes, as components, said elements of said Galois field $GF(2^m)$

$$\begin{pmatrix} S_0 & S_1 & \cdots & S_{l-1} \\ S_1 & S_2 & \cdots & S_l \\ \vdots & & \ddots & \vdots \\ S_{l-1} & S_l & \cdots & S_{2l-2} \end{pmatrix} \begin{pmatrix} \Lambda_1^{(l)} \\ \vdots \\ \vdots \\ \Lambda_l^{(l)} \end{pmatrix} = \begin{pmatrix} S_l \\ \vdots \\ \vdots \\ S_{2l-1} \end{pmatrix};$$

obtaining the solution of said Yule-Walker equation without
 10 conditional branching as the following determinants

$$\tilde{\Lambda}_i^{(l)} = \begin{vmatrix} S_0 & S_1 & \cdots & S_{l-1} \\ \vdots & \vdots & \ddots & \vdots \\ S_{l-i-1} & S_{l-i} & \cdots & S_{2l-i-2} \\ S_{l-i} & S_{l-i+1} & \cdots & S_{2l-i-1} \\ \vdots & \vdots & \ddots & \vdots \\ S_l & S_{l+1} & \cdots & S_{2l-1} \end{vmatrix}, i=1, \dots, l-1;$$

employing Jacobi's formula, $\Gamma_i^{(l+1)} \Lambda_0^{hat(l)} + (\Lambda_1^{hat(l)})^2 = \Lambda_0^{hat(l+1)} \Gamma_i^l$, to

enable the calculation of the solution $\tilde{\Lambda}_i^{(l)}$ (hereinafter referred to as
 $\Lambda_i^{hat(l)}$) to result in the calculation of the following determinants of

15 the symmetric matrices

$$\Gamma_i^{(l+1)} = \begin{vmatrix} S_0 & \cdots & S_{l-1-i} & S_{l+1-i} & \cdots & S_l \\ \vdots & & \vdots & \vdots & & \vdots \\ S_{l-1-i} & \cdots & S_{2(l-1-i)} & S_{2(l-i)} & \cdots & S_{2l-1-i} \\ S_{l+1-i} & \cdots & S_{2(l-i)} & S_{2(l+1-i)} & \cdots & S_{2l+1-i} \\ \vdots & & \vdots & \vdots & & \vdots \\ S_l & \cdots & S_{2l-1-i} & S_{2l+1-i} & \cdots & S_{2l} \end{vmatrix}$$

(where $i = 0, \dots, l$);

determining the number of errors to be the maximum matrix size
 that corresponds to said obtained solution that is not zero; and

20 determining whether said number of errors equals the maximum
 number of correctable errors.

14. (original) The storage medium according to claim 13, wherein
 the components of said determinants are syndromes that consist of said
 elements of said Galois field $GF(2^m)$.

15. (original) The storage medium according to claim 13, wherein
 said syndromes are generated by digital signals transmitted using
 wavelength division multiplexing.

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16. (original) The storage medium according to claim 13, wherein said program is used for at least one of the decoding of digital signals and error correction.

17. (new) The signal processing method according to claim 1, wherein obtaining the solution of said Yule-Walker equation is limited to addition and multiplication operations.

18. (new) The system according to claim 5, wherein means for obtaining the solution of said Yule-Walker equation is limited to addition and multiplication operations.

19. (new) The program according to claim 9, wherein obtaining the solution of said Yule-Walker equation is limited to addition and multiplication operations.

20. (new) The storage medium according to claim 13, wherein obtaining the solution of said Yule-Walker equation is limited to addition and multiplication operations.